

GULF COAST TO CALIFORNIA PIPELINE FEASIBILITY STUDY

CONSULTANT REPORT

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Gray Davis, Governor

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**PREPARED FOR
CALIFORNIA ENERGY COMMISSION**

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DRAFT



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EXECUTIVE SUMMARY

Assembly Bill No. 2098 by Migden directed the State Energy and Resources Conservation and Development Commission, in consultation with the State Fire Marshal, to study the feasibility of financing, constructing, and maintaining a new pipeline, or utilizing or expanding the capacity of existing pipelines, to transport motor vehicle fuel or its components from the Gulf Coast to California.

The California Energy Commission (Energy Commission) retained Interliance, LLC to prepare a feasibility study for a conceptual pipeline from the Gulf Coast to California. This report is the result of that study. The following are some of the observations contained herein:

- The conceptual pipeline will run from Galena, Texas, to Colton, California (a distance of more than 1,400 miles).
- Estimated costs for constructing a pipeline from the U.S. Gulf Coast to California are approximately \$800 million for a 12-inch pipeline and \$1.6 billion for a 24-inch petroleum products pipeline.
- Developing engineering designs, obtaining permits and construction would take a minimum of four years to complete following conceptual approval and financial backing.
- California supplied approximately 271 MPBD of petroleum products to Arizona and Las Vegas during 2000. Some portion of this volume could be retained for use in California if capacity to supply these other markets from the east were expanded and supply was available.
- Pursuant to the Energy Commission's supply and demand data, California demand growth for gasoline is expected to increase by 1.6 percent a year. In addition, when MTBE is phased out, California reformulated gasoline production will decline by 5 percent.
- Operation of this pipeline as a Strategic Fuel Reserve (SFR) during periods of refinery problems or fuel shortages may be less efficient than a reserve operated from a number of different storage tanks located throughout California.

The Interliance report does not address the potential viability of a conceptual pipeline to continuously supply California with transportation fuels from refiners located in Texas. In order to determine whether or not such a conceptual pipeline were to be a beneficial source of supply, a number of issues that are outside the scope of this study would have to be examined before any conclusive determination could be drawn.

The Energy Commission has identified the following questions:

- Are adequate supplies of transportation fuels available in the Gulf Coast for such a conceptual pipeline?
- Are transportation costs by marine vessel forecast to exceed estimated transportation costs for the pipeline?
- Are alternative sources of supply for California either not available or more expensive (delivered cost to California)?
- Will California's marine terminals, docks and storage tank infrastructure become constrained? and
- Will California's demand for imports be large enough and can they be sustained year around to justify a conceptual pipeline?

The Energy Commission will determine how to address these questions.

IA. RATIONALE FOR DEVELOPMENT OF PETROLEUM PRODUCT PIPELINES IN THE UNITED STATES

(1) GENERAL PURPOSE OF PIPELINES

Petroleum product pipelines play a major role in the transportation of refined products from refining centers and marine ports to consumers. During 2000, the 90,000-mile product pipeline network in the United States transported approximately 20 million barrels per day (BPD) of refined products, which consist of approximately 50 different grades of products. The types of products transported include various grades of gasoline, diesel fuel, turbine fuel, kerosene, and home heating oil. Fungible grades of products, such as California Air Resources Board (CARB) Phase II, conventional, and reformulated gasoline at various octane ratings, are batched through the product pipelines and stored in segregated storage tanks at the pipeline terminals. At the terminals, additives and detergents are generally added into the product as it is loaded onto trucks for delivery to gasoline stations.

Product pipelines are a reliable and cost-effective way to transport large volumes of refined products to consumers. Alternate methods of transportation include truck, rail, or marine tankers. From a comparative cost basis, economics favor pipelines although waterborne movement can be priced competitively with pipelines. Of course, marine movement is limited by geography. Because pipelines operate primarily underground, the impact on aboveground resources is minimal.

Some of the largest product pipelines in the world are located in the United States. The Colonial (1,500 miles) and Plantation (1,100 miles) pipelines transport refined products from the Gulf Coast refineries to consumer markets along the East Coast of the United States. The Explorer (1,400 miles) and TEPPCO (1,100 miles) pipelines are the dominant systems used to transport products from the Gulf Coast to the Midwestern region of the country.

(2) ENGINEERING FACTORS CONSIDERED IN PIPELINE DESIGN

Pipelines are normally designed in accordance with the U.S. Department of Transportation (DOT) Pipeline Safety Regulation 49 CFR Part 195 and ASME B31.4.

Pipeline design begins with the establishment of project objectives such as:

- Required throughput
- Origin and destination points
- Product properties such as viscosity and specific gravity
- Topography of pipeline route
- Maximum allowable operating pressure (MAOP)

With these assumptions as a basis, hydraulic calculations are performed to determine the following items:

- Pipeline diameter, wall thickness, and yield strengths
- Number of and distance between pump stations
- Pump station horsepower (hp) required

The calculations are usually performed using a hydraulic model with equations to describe the flow of fluids in a pipe. One key equation calculates pressure losses due to pipe friction. A second key equation calculates the maximum operating pressure with the thickness, diameter, and yield strength of the steel pipe as input.

Also, different scenarios are normally examined to establish the most economic project. For example, pipeline diameter can be increased to reduce the number of pump stations necessary but the requirement for turbulent flow conditions for the fluid limits how large the diameter can be. In addition, the wall thickness of the pipe can be increased to reduce diameter but constructability of the pipeline is a limiting factor as wall thickness increases.

(3) PERMITTING ISSUES

The permitting phase of a pipeline project involves a comprehensive review of safety and environmental concerns related to the project. Numerous regulatory agencies have requirements for pipeline projects, and the design of the pipeline must conform to these standards. After the project is reviewed and found to be in conformance, permits are issued by the various agencies.

For a large interstate project, one of the agencies serves as the “primary” or “lead” agency for efficient processing of permits. Typically, the agency that has the most land jurisdiction serves as the lead agency.

A partial list of agencies normally involved in a pipeline projects follows:

- U.S. Environmental Protection Agency (EPA)
- U.S. Army Corps of Engineers (Corps)
- U.S. Fish & Wildlife Service (USFWS)
- U.S. Department of Transportation (DOT)
- Bureau of Land Management (BLM)
- Air Resource Boards (state level)
- Water Resource Boards (state level)
- Occupational Safety and Health Administration (OSHA)
- Other local jurisdictions

The permitting of a large pipeline project could involve the acquisition of 2,000 to 3,000 permits and could take 2 years or more to accomplish. The permitting agencies normally require that the applicant perform mitigation measures to minimize any adverse impacts on the environment as a result of the pipeline projects.

Environmental studies are conducted to analyze various pipeline route alternatives to help select the most feasible option in terms of minimizing the impact on the environment and the safety of people who live in the vicinity of the proposed route.

These environmental studies follow procedures established by federal and state law, sometimes resulting in an Environmental Assessment (EA) or Environmental Impact Statement (EIS).

Finally, permission must be obtained to use an easement corridor, generally referred to as the pipeline right-of-way (ROW). Owners of private and public property negotiate with the pipeline companies and sign leases for the use of their land.

(4) GENERAL COSTS OF PIPELINE SYSTEMS

The construction of a new pipeline is a capital-intensive venture. However, after the project is completed, maintenance capital requirements are minimal relative to original costs and with proper corrosion control, the useful life of the coated steel pipeline is extensive.

The cost of a new pipeline will mainly depend on its geographic location and diameter. The costs increase with larger diameters and more complex terrains. A new pipeline in the Arctic region will be more costly than a new line in the flat, remote areas of the Southwest United States. Also, construction costs in congested urban areas, such as Los Angeles, will be more costly than rural areas.

The major categories of pipeline costs with corresponding historical average percentages in relation to total cost are as follows:

Materials	23%	Line pipe, pipe coating, cathodic protection
Labor	40%	Construction cost for transportation, welding, and installation of pipe in ditch
ROWs	10%	Acquisition cost and damages
Miscellaneous	27%	Surveying, engineering, administration and overhead, supervision, regulatory filings, and telecommunication facilities

For the 115 land projects surveyed for the 1999 to 2000 period, the total average cost per mile was \$1,511,182. However, these projects included pipe diameters ranging from 4 to 48 inches and pipe lengths ranging from 0.1 to 140 miles. The unit cost of a project will increase with diameter and decrease with length. (Note: The above data were obtained from selected documents from Federal Energy Regulatory Commission [FERC] CY2000, 1999 Annual Construction Reports, and articles from the Oil and Gas Journal.)

(5) FINANCING STRATEGIES

Because new pipeline projects are capital intensive, they typically require shipper agreements that provide sufficient revenue for recovery of capital and a reasonable return on investment (ROI). These agreements may be long term (10 to 20 years) and require that the shipper maintain an acceptable credit rating over the course of the commitment.

These shipper agreements are used as security for debt financing of pipeline projects. Debt financing in the 50% to 70% range is typical for large pipeline projects. With proper shipper agreements, debt financing can be obtained on a non-recourse basis at interest rates ranging from 140 to 300 basis points above current borrowing rates. The pipeline investors provide the equity portion of the capital investment.

(6) ECONOMIC FACTORS NECESSARY FOR PROFITABLE PROJECTS

Because they are normally backed by shipper commitments and not subject to variations in commodity prices, pipeline investments are generally considered to be “low risk” relative to other types of energy projects such as drilling for oil and gas. For this reason, minimum ROIs can vary in the 10% to 15% after-tax range.

Pipeline transportation of refined products is subject to regulation by FERC and/or state regulatory agencies such as the California Public Utilities Commission (CPUC). The FERC has jurisdiction on interstate product movements, and state agencies regulate intrastate transportation. The basic objective of pipeline transportation regulation is to ensure that tariff rates are just, reasonable, and nondiscriminatory.

A pipeline company normally publishes tariff rates for transportation of products between specific origin and destination points. Pipeline tariff rates are normally derived by dividing the annual revenue requirement by the total number of barrels transported.

The main components of annual revenue requirement (or “cost of service”) are as follows:

- Operating and maintenance expense
- Depreciation (total investment over 20 to 30 years)
- Return on debt (7% to 8%)
- Return on equity (12% to 15%)
- Income tax allowance

Total revenue requirement

This simplified methodology is based on FERC’s historical “cost-of-service” rate-making methodology. (It should be noted that this is a very simplified representation of regulatory cost-of-service models, and there are many variations based on past rate cases with the FERC.)

The FERC traditional cost-of-service methodology was reformed in 1995 under the Energy Policy Act of 1992 (EPACT). This act called for the FERC to establish a simplified and generally applicable approach for petroleum pipeline rate-making. In response, the FERC prescribed an indexing methodology for setting rate ceilings beginning in 1995. Also, in addition to traditional cost of service and indexing, pipeline companies could also use market-based rates or negotiated settlement rates.

Therefore, for existing pipelines, four rate-making methodologies are now available:

- Cost of service
- Indexing
- Market based
- Settlement

For new pipelines, either cost of service, market based, or negotiated rate methodologies are available. A negotiated rate is one that is agreed to by at least one nonaffiliated company that intends to use the service in question. However, if another shipper protests the negotiated rate, then the rate may be required to be cost justified.

IB. SOUTHWEST U.S. PETROLEUM PRODUCT PIPELINE SYSTEM

(1) DESCRIPTION OF EXISTING INFRASTRUCTURE

A map of the current major refined product pipelines in the Southwest United States is shown on Figure 1. (Note: All figures cited herein are presented in Appendix A.) The Kinder Morgan (KM) western pipeline system is the largest pipeline system used to transport refined products (gasoline, diesel, and jet fuel) from the three California refining centers to the various product terminals both within and outside of California. The KM western system is comprised of approximately 3,400 miles of pipeline varying in diameter from 4 to 24 inches. The KM pipeline system delivers products to 14 KM distribution terminals, third-party terminals, several military installations, commercial airports, and other interconnecting pipelines. The KM system also transports products to Nevada and Arizona as well as California. It should be noted that Phoenix, Arizona, is currently supplied by KM from both the California refineries and from product originating in El Paso, Texas.

Product terminals in El Paso, Texas, currently receive supply from the following sources:

- Chevron El Paso refinery
- Navajo pipeline system
- Diamond Shamrock Enterprises (DSE) pipeline
- Equilon pipeline

The capacity and 2000 throughputs of these facilities are shown on Figure 1.

In addition to the existing pipelines delivering to El Paso, the Longhorn pipeline is scheduled to begin service during the second or third quarter of 2002 from Houston to El Paso. Longhorn will have an initial capacity of 72 thousand barrels per day (MBPD) with expansion capabilities up to 225 MBPD.

It should be noted that local product pipelines and terminals are not shown on Figure 1 for clarity reasons. However, these facilities transport a significant amount of product mainly for local consumption. For example, the following proprietary terminals receive product directly from their affiliated refineries and distribute product to their own gasoline stations or third-party stations in California:

- BP – Vinvale

- BP – Southgate
- Chevron – Montebello
- Chevron – Huntington Beach
- Exxon Mobil – Atwood
- Exxon Mobil – Vernon
- Phillips – Los Angeles Terminal
- Phillips – Richmond
- Equilon – Carson/Van Nuys

(2) PIPELINE SEGMENT ANALYSIS

The Southwest refined products pipelines infrastructure is further defined by functional segments as shown in Tables 1 through 4. (Note: All tables cited herein are presented in Appendix B.) The following pipeline segment details are identified: origin/destination, length, diameter, capacity, 2000 throughput, and type of products handled.

The KM pipeline segment data were obtained from KM representatives, and data for the other pipelines were obtained from various Web site sources.

(3) PIPELINE TARIFF RATES

The tariff rates for Southwest U.S. petroleum product pipeline systems are shown on Figure 2. The KM rates were obtained from the June/July 2001 tariff rate filings made by KM with the CPUC and FERC.

The Longhorn pipeline tariff rates are estimates provided by Longhorn during an interview held on August 9, 2001. Longhorn was granted market-based rates by the FERC, and Longhorn plans to file the final rates 30 days before startup of the pipeline. Longhorn plans to assess the transportation market at the appropriate time and set rates by product type within a specific market.

Their current tariff rate estimates are as follows:

- El Paso gasoline – 4 to 5 cents/gallon (168 to 210 cents/barrel)
- Phoenix gasoline – 6 to 7 cents/gallon (252 to 294 cents/barrel)
- High sulfur diesel – 3 to 4 cents/gallon (126 to 168 cents/barrel)
- Aviation jet – 5 to 6 cents/gallon (210 to 252 cents/barrel)

It should be noted that these are estimates that could change upon startup of the pipeline.

Based on this current tariff structure, the following items are noteworthy:

Competing transportation cost to Phoenix

The current transportation cost to Phoenix on the KM system from California is \$1.31 per barrel, excluding ancillary costs such as gathering, terminaling, loss allowance, and other related costs. The estimated cost from the Gulf Coast refineries via the Longhorn/KM system is \$2.52 to 2.94 per barrel. Because the estimated transportation cost on Longhorn is \$1.21 to 1.63 per barrel higher, this would suggest that product prices in the Gulf Coast would have to be lower than California by this amount in order for eastern movements to occur. However, product pricing is dependent on a variety of items and represents a complex issue that is outside the scope of this study.

Competing transportation cost to West Coast

From time to time, refined products are transported from the Gulf Coast to the West Coast via marine tankers. Theoretically, supplies could be delivered to the Arizona market via the Longhorn pipeline, which could back up barrels into California, thus reducing or eliminating the need for tanker movements from the Gulf Coast to California. Of course, product specifications would be a major consideration in this hypothetical scenario.

From an economic basis, the estimated Longhorn tariff rate of \$2.52 to \$2.94 per barrel would have to be competitive with tanker costs from the Gulf Coast to Southern California in order for Gulf Coast refineries to use Longhorn. According to the CEC, marine tanker rates have ranged from \$4.20 to \$7.56 over the last couple of years and the CEC expects these rates to increase over the near-term as the number of domestic ships (U.S. Jones Act vessels) decline due to retirement of older vessels. Therefore, theoretically, it seems reasonable that there could be an economic advantage to increase deliveries to the Arizona market from the east, if adequate pipeline capacity existed between El Paso and the Phoenix/Tucson markets.

It should be noted that the above logistics are very simplified and there are many other complex factors involved that will impact how refined products are ultimately transported to end markets.

(4) REFINERY CAPACITIES

A list of the individual California refineries, including an estimate of crude capacity for 2000, is provided in Table 5. Each individual refinery has unique characteristics that include crude run rates, product production, and logistics systems. Consolidation in the California refining business continues with several mergers underway at the current time.

Significant capital investment has been made in the California refineries to produce cleaner burning fuels. According to the CEC, these refineries produce several grades of gasoline including conventional (Reno and Las Vegas), winter oxygenated (Phoenix, Tucson, and Las Vegas), reformulated (Phoenix), and CARB Phase 2 (California). The existing pipeline infrastructure is very efficient in terms of transporting these various grades of product to the proper location.

1C. PETROLEUM PRODUCT PIPELINE SYSTEM CONSTRAINTS AND OUTLOOK

(1) LINE SEGMENTS AT OR NEAR CAPACITY

Based on the capacity and throughput information presented in Tables 1 through 4, the KM pipeline from El Paso to Tucson appears to be approaching capacity.

(2) PRODUCT SUPPLY/DEMAND BALANCE 2000 THROUGH 2010

In order to identify potential future infrastructure constraints, product supply/demand balance estimates through 2010 were developed. This information is based on data provided by CEC, used for study purposes only, and could be subject to change.

The year 2000 refined product balance for the Southwest region is shown on Figure 3 and detailed in Table 6. A further breakdown of Table 6 is provided in Table 7 (gasoline) and Table 8 (diesel and jet fuel).

The 2000 California product balance can be summarized as follows. The California refineries produced an average of 1,584 MBPD of gasoline and distillate (diesel and jet fuel). This production was supplemented with 138 MBPD of marine imports, both foreign and domestic, resulting in a total product supply of 1,722 MBPD. The California consumption was approximately 1,442 MBPD, with the balance of 280 MBPD being exported out of state. The California exports consisted of 32 MBPD to Oregon by tanker, 146 MBPD to Nevada by pipeline, 126 MBPD to Arizona by pipeline, and 9 MBPD by truck to various out-of-state locations.

There are several other noteworthy items for the year 2000 balance:

- Nevada's 2000 demand of approximately 147 MBPD was supplied almost entirely by imports from California via KM pipelines to Reno and Las Vegas.
- Arizona's 2000 demand of approximately 248 MBPD was supplied primarily by KM's western system (125 MBPD) and KM's eastern system (87MBPD) from El Paso, Texas.
- California supplied approximately 271 MPBD of petroleum products to Arizona and Las Vegas during 2000. Some portion of this volume could be retained for use in California if capacity to supply these other markets from the east were expanded and supply was available.

For projections beyond 2000, the following assumptions were made:

- U.S. Census Bureau growth rates are used for population growth and product demand.
- California refinery production will creep or expand 1.0% per year.
- Gasoline demand in Arizona and Nevada will increase at the same rate as population growth.
- Refined product demand outlook for California was obtained by using the forecast derived by the California Energy Commission.
- No new refineries will be built or shut down in California, Nevada, Arizona, or New Mexico.
- New Mexico will continue to be an exporter to Arizona of approximately 18.8 MBPD.
- The potential decrease of production volume, estimated at approximately 5%, due to replacement of methyl tertiary butyl ether (MTBE) with ethanol is included in current projections.

As shown in Table 9, total product demand for the Southwest region is projected to increase as follows:

Product Demand (MBPD)

	2000 Demand	2005 Demand	2010 Demand
California	1,442	1,596	1,769
Arizona	248	275	298
Nevada	147	165	180
Total	1,837	2,036	2,247

The corresponding incremental increase in product demand, with year 2000 as the base year, is as follows:

Change in Demand (MBPD)

	2000	2005/2000	2010/2000
California	0	154	327
Arizona	0	27	50
Nevada	0	18	33
Total	0	199	410

Based on the previous assumptions, California refineries are not expected to be able to supply both local consumption and increased exports to satisfy growing needs in Nevada and Arizona for the next 10 years.

This projection can be best understood by reviewing the California refined product supply/demand forecast summary in the table below.

(MBPD)	2000	2005	2010
<u>Supply</u>			
Refinery Production	1,584	1,561	1,641
Marine Imports	138	365	470
Total	1,722	1,926	2,111
<u>Demand</u>			
California Consumption	1,442	1,596	1,769
Marine Net Exports	1		
P/L Export to Reno, Nevada	36	41	47
P/L Export to Las Vegas, Nevada	109	124	135
P/L Export to Phoenix, Arizona	126	155	152
Truck Exports	9	9	9
Total	1,723	1,926	2,110

Supporting product balances for 2005 and 2010 are also included in Table 10 and 11 and shown on Figures 4 and 5.

(3) DISCUSSION OF ISSUES

From a pipeline standpoint, the key points of this analysis are as follows:

- Throughput on the KM line from Colton to Las Vegas would increase from 109 MBPD to 135 MBPD by 2010. Because the capacity of the Las Vegas line is 138 MBPD, throughput is nearing capacity on this pipeline segment during the latter part of the forecast period.
- Throughput on the KM line to Phoenix would increase from 125 MBPD to 155 MBPD in 2005. However by 2010, throughput would decrease to 152 MBPD because there would not be enough California supply. (Of course, this could be rectified by increased marine imports into California.) Because capacity of this line is 200 MBPD, there is no constraint in this segment.
- In 2010, there would be a need for additional product supply from Texas. Because the KM El Paso to Phoenix line has a capacity of 95 MBPD, there could be justification to increase capacity in the 2008 to 2010 timeframe.

- Based on the previous assumption, there does not appear to be a supply shortfall in terms of the California/Nevada/Arizona demand projections. However, the product balance is very sensitive and several events could change this outlook. For example, if California reduced marine imports and reduced exports to Arizona, there would be demand for Longhorn volumes. A different scenario that could cause Longhorn volumes to move into Arizona is competition for the Arizona market by the Gulf Coast refineries and marketers. These entities could price their products to capture market share in Phoenix and Tucson. The California refineries would then be faced with several business decisions such as reducing imports, reducing refinery utilization, etc.
- Because the capacity of Longhorn can be increased from its initial 72 MBPD to 225 MBPD, it could be used as the “first leg” of an alternative pipeline system to the new conceptual pipeline.

1D. CONCEPTUAL PETROLEUM PRODUCT PIPELINE BETWEEN U.S. GULF COAST AND CALIFORNIA

(1) PURPOSE OF CONCEPTUAL PIPELINE

In order for the Gulf Coast to California pipeline to be properly sized, the purpose of the project must first be established. The California Energy Commission (CEC) has established two potential operational scenarios for this pipeline:

- Operate as “the” strategic fuel reserve (SFR) currently under study by the CEC
- Operate as a fill line for an SFR storage facility to be established in California

The design criterion for the SFR is to provide a capacity of 2 million barrels of refined products, which is equal to the production of the largest California refinery over a 2-week period.

This equates to a daily production of approximately 143 MBPD. In addition, the SFR should be capable of operating two times per year, mainly when there is an unexpected refinery shutdown.

The size and cost of the conceptual pipeline will vary dramatically depending on the ultimate use of the pipeline. The ultimate use of the pipeline will depend on the final configuration of the SFR, supply/demand scenarios, and the development of similar projects such as the Longhorn pipeline.

OPERATE AS “THE” STRATEGIC FUEL RESERVE

In this scenario, the conceptual pipeline must be sized to provide the daily requirement of 143 MBPD in the event of an unexpected refinery shutdown. To achieve this flow rate, a 24-inch-diameter pipeline will be required.

The main problem with this concept is the very limited use (4 weeks per year) of the pipeline. Pipelines are normally designed to operate continuously and are shut down only for maintenance activities. Interface mixing and the product shelf life are major concerns or constraints for this alternative.

Operating the pipeline as a Strategic Fuel Reserve would be less efficient than a reserve that was operated from a number of different storage tanks located throughout the State.

OPERATE AS A FILL LINE FOR THE SFR

In this scenario, the conceptual pipeline would be used to refill a permanent SFR in Southern California after a refinery-upset condition. Because the design basis of the SFR is 4 million barrels per year (2 million per event with two events per year), the required flow rate of the pipeline would be only 11 MBPD if operated on a continuous basis.

This low flow rate can be handled with a very small-diameter pipeline in the 4- to 6-inch range. However, it is not practical or cost effective to install a small-diameter line for such a long distance (estimated to be approximately 1,400 miles from Houston, Texas, to Colton, California). For this long-distance route, it is recommended that a minimum 12-inch-diameter pipe be installed. The capacity of a 12-inch-diameter line is approximately 50,000 MBPD.

CONCLUSION

Based on the above analysis, a 24-inch-diameter pipeline will be required if the pipeline is to operate as the SFR and a 12-inch-diameter pipeline is required if the conceptual line is to be used as a fill line for a permanent SFR to be constructed in Southern California.

(2) DESIGN BASIS

Based on the requirements identified in the previous section, there are two sets of design criteria. One is for a 24-inch-diameter line and another for a 12-inch-diameter pipeline. A 24-inch-diameter line can transport 150,000 BPD of gasoline from Houston to Colton using three 5,000-hp pumping stations at the specific locations shown on the pipeline route map (Figure 6). A 12-inch-diameter pipeline can transport up to 50,000 BPD of gasoline using nine 1,750-hp pumping stations at the locations shown on Figure 6. In addition, Figure 7 shows the hydraulic profile for the 24-inch diameter pipeline case.

(3) ROUTE CRITERIA AND ASSUMPTIONS

The following criteria and assumptions were considered during selection of the proposed pipeline route:

- Although a combination of gasoline, diesel, and jet fuel will most likely be batched through the pipeline, gasoline was the only product considered in the hydraulic calculations.
- ROW selection focused on existing pipeline ROWs to minimize the environmental impact.

- Avoidance of the Edwards aquifer in Texas or maximizing the distance between the pipeline and the aquifer.
- Where possible, the routing was selected to avoid or minimize the impact on environmentally sensitive areas.
- Permitting and approval can be obtained for the proposed ROWs.

(4) ROUTE DESCRIPTION

The origin of the pipeline was established at the Longhorn pipeline terminal in Galena Park, Texas, with the termination point at the KM terminal in Colton, California, resulting in a 1,415-mile-long pipeline. The origin of Longhorn was selected as the origin of the conceptual pipeline because this location has access to the GATX terminal and most of the Gulf Coast refineries including BP, Valero, and Exxon Baytown. Colton, California, was selected as the termination point because it is one of KM's major hubs from which product can be distributed to numerous Southern California locations and Las Vegas. Also, incremental supply at Colton could eliminate the need for imports from Northern California, thus creating extra supply in the northern half of state.

The proposed pipeline is routed through Texas, New Mexico, Arizona, and California, generally following the route of Highway 10 from El Paso west. In Texas, the pipeline was routed northerly and then westward to minimize the impact on the environmentally sensitive area of the Edwards aquifer and its related drainage area.

TEXAS

The pipeline will run from Galena Park, Texas, to El Paso, Texas, along or near existing pipeline ROWs. The pipeline will run north out of Galena Park along the Arco (oil) and Texaco (oil) pipeline ROWs to just west of milepost 200 where it will pick up the American Petrofina (oil) pipeline ROW. West of milepost 400, the pipeline will pick up the ROWs of American Petrofina (oil) and Seminole (product) pipelines. Just east of milepost 662, the pipeline will pick up the ROWs of All American (oil), Chevron (oil), Navajo Refining (product), and Shell (product) pipelines.

NEW MEXICO

The pipeline enters New Mexico at milepost 717 and will pick up the ROWs of El Paso (gas), All American (oil), and Shell (product) just east of milepost 824.

ARIZONA

The pipeline will enter Arizona at milepost 881, then west of milepost 1000 the line will be adjacent to the El Paso (gas) and All American (oil) pipeline ROWs to the California border.

CALIFORNIA

The pipeline will enter California at milepost 1235 where the pipeline will run adjacent to the Southern California Gas pipeline ROW to the edge of the Riverside/San Bernardino County line (milepost 1392) where the line will run adjacent to the Questar (gas) and KM (product) pipeline ROWs. The pipeline will terminate at the Colton terminal, milepost 1415.

Table 12 shows the mileage of pipeline by county.

(5) ISSUES ASSOCIATED WITH PIPELINE CONSTRUCTION

Selection of a route that relies on existing pipeline ROW should mitigate many of the permitting and approval issues of building a new pipeline. However, it will not eliminate them. Issues that will have to be addressed or have the potential to impact the construction or operation of the pipeline are identified below.

APPROVAL OF RIGHT-OF-WAY AND PIPELINE CONSTRUCTION AND OPERATIONS

During the approval process, design and/or operation of the pipeline may have to be altered to provide for mitigation issues identified during the approval process.

Approval of the pipeline routing will involve federal agencies such as the FERC, DOT, and EPA. In addition, the line will cross four states: Texas, New Mexico, Arizona, and California. Therefore, these four states, as well as local jurisdictions, will also be involved in the approval process.

Because the majority of the new pipeline is located in existing pipeline ROW, acquisition of ROW for the new line is not expected to pose a serious constraint. However, representatives of the new pipeline will have to negotiate with the landowners for ROW on the new pipeline.

The pipeline traverses an area that contains approximately 5% of the population of the United States (13,200,666). Population density near the pipeline may impact the safety and environmental mitigation measures required for operation of the pipeline. Approximately one third of the pipeline (462 miles) traverses counties with a population density greater than 100 persons per square mile. Table 12 provides a relative indication of the population density along the pipeline route. The data are presented based on total population in a given county that the pipeline route crosses.

At a minimum, an EA will be required. If it is determined that the project will require an EIS to be prepared for any of the jurisdictions that the line crosses, the process could result in a significant delay. As an example, the Longhorn EA was expected to take 6 months but ended up taking 2 years for a variety of reasons.

Issues that will have to be addressed include the impact of the pipeline on:

- Safety
- Groundwater
- Surface water impounds, lakes, rivers, and streams
- Historical sites
- Environmentally sensitive areas
- Endangered species impacted by construction and/or operation of the pipeline
- Air quality impact of pumping station and other operational activities of the pipeline

REGULATORY AGENCIES

Regulatory agencies that may have input into and an impact on the approval process for construction and operation of the pipeline include those listed below.

Governing Area	Regulatory Agency
Federal	<ul style="list-style-type: none"> • U.S. Department of Transportation (DOT) • U.S. Environmental Protection Agency (EPA) • U.S. Fish and Wildlife Service (USFWS) • Bureau of Land Management (BLM) • Department of Defense (DOD) • U.S. Army Corps of Engineers (Corps)
Texas	<ul style="list-style-type: none"> • Railroad Commission of Texas (RRC) • Texas Natural Resource Conservation Commission • County Commissioners Court • Texas Department of Transportation (TxDOT)
New Mexico	<ul style="list-style-type: none"> • New Mexico Public Regulation Commission • New Mexico Department of Transportation • New Mexico Department of Environmental Quality • New Mexico Office of Cultural Affairs • New Mexico Department of Air Quality
Arizona	<ul style="list-style-type: none"> • Arizona Corporation Commission – Office of Pipeline

Governing Area	Regulatory Agency
	Safety
	<ul style="list-style-type: none"> Arizona Department of Transportation (ADOT) Arizona Department of Environmental Quality
California	<ul style="list-style-type: none"> California Public Utilities Commission (CPUC) California Energy Commission (CEC) Air Resources Board (ARB) Local Air Quality Management Districts California Department of Fish and Game (CDFG) California Department of Transportation (Caltrans) California Department of Forestry and Fire Protection, Office of Fire Marshal, Pipeline Safety Division
Cities and Court Agencies	<ul style="list-style-type: none"> Agencies near the pipeline route

(6) OPERATIONAL CONSIDERATION

LINE FILL

Approximately 4.1 million barrels of product will be required to fill the 24-inch line from Houston, Texas, to Colton, California. Total pumping time at rated flow, from Houston into Colton, will be approximately 27 days based on a pipeline velocity of approximately 3.3 feet per second. Table 12 shows the pipeline fill requirements in each state by county.

PUMPING STATIONS

To achieve the desired 150,000-BPD flow of the pipeline, two pump stations will be located along the pipeline. It is estimated that the size of each station will be approximately 4,160 hp. Both pump stations will be located within the state of Texas at mileposts 312 and 594.

BLOCK VALVES

Block valves will be installed as required by the federal DOT, state, and local regulations.

(7) ALTERNATIVE PIPELINE EVALUATION

A review was performed to determine if there were viable existing pipelines available that would alleviate building any portion of the conceptual pipeline from

the Gulf of Mexico coast to California. Both natural gas and crude oil pipelines were evaluated including planned projects. Figure 8 illustrates one possible alternative.

This alternative pipeline consists of the following three sections:

- Longhorn pipeline that should have excess capacity of at least 150 MBPD if expanded to its ultimate capacity of 225 MBPD
- A new section of pipeline from El Paso, Texas, to Needles, California
- The Questar Southern Trails pipeline from Needles, California, to Long Beach, California

Currently, four interstate pipelines deliver natural gas to California. The capacity of the interstate delivery system to California is barely above the daily consumption rate. There is also concern that the system will not be able to meet future demand, which has spawned several pipeline projects to increase the supply of natural gas to California. Two of these projects involve converting existing crude oil lines to natural gas.

The crude-oil All American pipeline has been purchased by El Paso Natural Gas Company. FERC has approved the Line No. 2000 project that would convert 785 miles of pipeline from a point near the California border at Ehrenberg, Arizona, to McCamey, Texas, to natural gas. This would serve as a loop to El Paso's existing system that serves western markets and provide an additional 230 million cubic feet of natural gas service per day to meet increased demand in California and the Southwestern United States. This pipeline is therefore not considered available as an alternative.

The Southern Trails project proposed by Questar has received regulatory approval from FERC and formal certification from the California State Lands Commission. The project will convert the former Four Corners pipeline from crude oil to natural gas. The pipeline extends from the Four Corners area, where the states of Utah, Colorado, New Mexico, and Arizona meet, to Long Beach, California. The project is divided into two zones. The eastern zone extends from the San Juan Basin in New Mexico to the California state line at Needles. The western zone extends from Needles to Long Beach. Questar indicated in its SEC Form 10-K filing dated March 26, 2001, that the western segment "needs additional market support and decisions by the California Public Utilities Commission to support competition for transportation volumes." The California segment could possibly be considered as an alternative for conversion to a refined products line if market conditions and regulatory actions do not support its conversion to natural gas. The purchase of Questar gas line should be a lower cost alternative versus construction of a new pipeline for the California corridor.

The new section of pipeline connecting the Longhorn pipeline to the California Southern Trails pipeline would be approximately 600 miles long. The cost of this

24-inch pipeline is estimated to be approximately \$528 million. The cost of purchasing and converting Questar to crude is unknown and will depend on many factors including the condition of the pipeline.

A detailed conceptual study of this alternative would be required to determine its viability. The factors impacting viability of this alternative include:

- Market conditions and regulatory actions could change to support the current planned Southern Trails conversion to natural gas.
- The capacity of the Longhorn pipeline, currently planned at 225,000 BPD, could be challenged to supply the additional conceptual pipeline capacity of 150,000 BPD.
- The time required to build the new connecting line could be at least 12 months less, or 3 years total versus 4 years for the conceptual pipeline construction.
- The costs of converting the 200-mile segment of the California segment from crude oil to refined product and repair or replacement of any segments as needed would not be significant as compared to construction of a new pipeline. Questar estimates the total costs for the more expensive conversion of 700 miles of pipeline to natural gas at \$155 million.
- Major construction in the most populous areas along the conceptual route in the vicinity of Los Angeles would be avoided.
- The total transportation costs to move product from the Gulf of Mexico coast to California should be lower using the alternative system versus the conceptual pipeline.

(8) INTERMITTENT PIPELINE OPERATION ISSUES

Pipelines are typically designed to operate on a continuous basis, and shutdowns of considerable length in time present numerous technical issues. The conceptual pipeline from the U.S. Gulf Coast to California would operate on a very limited basis if its sole purpose is to operate as the SFR.

The following issues should be closely evaluated before a decision regarding intermittent operation is made:

1. The maximum length of time that product could be stored in the line is limited by gasoline shelf life and other items. The 24-inch-diameter conceptual pipeline has a line fill of approximately 4.1 million barrels, and if the pipeline is used twice per year to provide 2.0 million barrels per event, then the line fill would be cycled once per year.

2. Stopping product flow will generate significant interface material (transmix) that must be reprocessed. Transmixing erodes the margin that exists between a premium product and a lower grade and less expensive product. A transmixed section of fuels is normally blended into lower grade product streams or piped out at a loss to be reprocessed back into individual product streams. In the case of one south Texas pipeline, transmixing was responsible for approximately \$1 million per month in lost revenues.
3. The feasibility should be determined, both operationally and economically, of going to a single product line pack prior to securing pipeline flow to eliminate loss of batch segregation.
4. Additional storage tanks (breakout tanks) may be appropriate to provide the flexibility to temporarily stop or buffer different pipeline segments.
5. Additional valve stations and double block-and-bleed type valves may be required to provide batch isolation during no-flow conditions.
6. EPA regulations similar to those governing tank storage of refined products (40CFR280) could be applied if product is routinely stored for lengthy periods.
7. Most pipeline leak detection systems are based on flow conditions, not stagnate head. It is especially difficult to determine the location of a leak without flow until it manifests itself on the ground surface. The primary leak detection systems that depend on flow conditions are:
 - Simple mass flow calculations
 - Pressure drop measurements and analysis
 - Ultrasonic detection
 - Statistic data from Supervisory Control and Data Acquisition (SCADA)
8. Formation of deposits will increase under no-flow conditions, requiring more frequent cleaning.
9. Possible formation of gas pockets that cannot be vented could lead to severe water hammer.
10. In addition to increased transmix generation, there is also the concern with loss of homogeneity within single product batches following extended stagnancy. To eliminate this concern in tanks, mixers are used to ensure a homogeneous mix and that test samples are representative

of entire batch and not just the material composition at the sample point. Although the material in the pipeline would be tanked prior to use, the grade of the product may not meet per-gallon specifications if significant stratification occurred and mixing was not uniform when flow is resumed.

1E. CONCEPTUAL COST ESTIMATE AND SCHEDULE FOR U.S. GULF COAST TO CALIFORNIA PIPELINE

(1) CONCEPTUAL PIPELINE COST ESTIMATE

The total cost for installation of the conceptual pipeline described in Section 1D is estimated at \$806 million for a 12-inch pipeline and \$1.6 billion for a 24-inch pipeline. This is a conceptual “order-of-magnitude” estimate and is based on historical cost data. The major cost components are broken down as follows:

Component	Costs		Assumption
	12-inch	24-inch	
Main Pipeline	\$524 million		Conventional trenching installation of 1,415 miles of 12-inch-outside-diameter steel pipe at an average of \$370,000/mile
		\$1,132 million	Conventional trenching installation of 1,415 miles of 24-inch-outside-diameter steel pipe at an average of \$800,000/mile
Road and Waterway Crossings	\$50 million	\$50 million	50 directional drills underneath major highways and waterways at \$1,000,000 each
Pump Stations	\$32 million		Nine pump stations rated at 1,750 hp each at \$2,050 per hp
		\$18 million	Three pump stations rated at 5,000 hp each at \$1,200 per hp
Metering and Control	\$14 million	\$6 million	Telecommunications and SCADA equipment at each pump station and the end point at \$1.4 million for each installation
Contingency	\$186 million	\$360 million	A 30% contingency based on the conceptual nature of the project design
Total:	\$806 million	\$1,566 million	

The above costs are in today's U.S. dollars and include the applicable material, construction, ROW, land, damages, survey, engineering, inspection, administrative, legal fees, permitting, project management, and operating and maintenance facilities associated with the installation. Supporting historical cost data and references for the above estimates are included in Tables 13 to 15. The values used in the above assumptions are generally based on these data with engineering judgment applied to account for the differences between the proposed project and the historical information to achieve conservative but reasonable results.

The conceptual pipeline cost estimate is a construction estimate for feasibility purposes only. It does not account for the costs of prolonged construction delays, which are often encountered during a project of this magnitude due to landowner disputes, challenges from special interest groups, or unanticipated cultural and environmental findings during construction.

The total estimated cost for the proposed project is comparable to the recently completed U.S. portion of the Alliance natural gas pipeline, which amounted to \$1.33 billion. The U.S. portion of the Alliance pipeline is 888 miles of 36-inch-diameter pipe, which crosses four states from the Canadian border in North Dakota to the Chicago area hub in Illinois. The Alliance project construction took 4 years from the initial FERC application in December 1996 to commercial operation in December 2000. The Alliance pipeline involved larger pipe (36-inch versus 20-inch) but fewer miles (888 versus 1400). The northern winter weather was a factor for Alliance; however, the more mountainous terrain that the proposed project must deal with would approximate this on a conceptual cost basis. Routing for both projects is primarily on previously disturbed ground in rural areas, which reduces the environmental and cultural impact of construction.

(2) CONCEPTUAL PIPELINE SCHEDULE

A project of this size is estimated to require 4 years to complete following conceptual approval and initial financial backing. The estimated duration of the major phases of the project is broken down as follows:

Phase	Duration	Explanation
Engineering and Design	6 months	Specific pipeline surveys and design information must be completed to provide input into the permitting process.
Permitting and Initial Material Procurement	18 months	The lengthy process of preparing, submitting, addressing questions and concerns, and obtaining applicable regulatory agency approvals. Orders for pipeline materials would be placed once a permit for a specific section is obtained.
Construction and Testing	24 months	This accounts for long lead-time material, primarily pipe. Several segments of the pipeline would be laid concurrently as material is available.
Total	4 years	

The above schedule is a construction estimate for feasibility purposes only. It does not account for prolonged delays during the permitting and construction phases, which are often encountered during a project of this magnitude due to landowner disputes, challenges from special interest groups, or unanticipated cultural and environmental findings.

APPENDIX A

FIGURES

Figure 3. Year 2000 Southwestern States Refined Product Balance Estimate

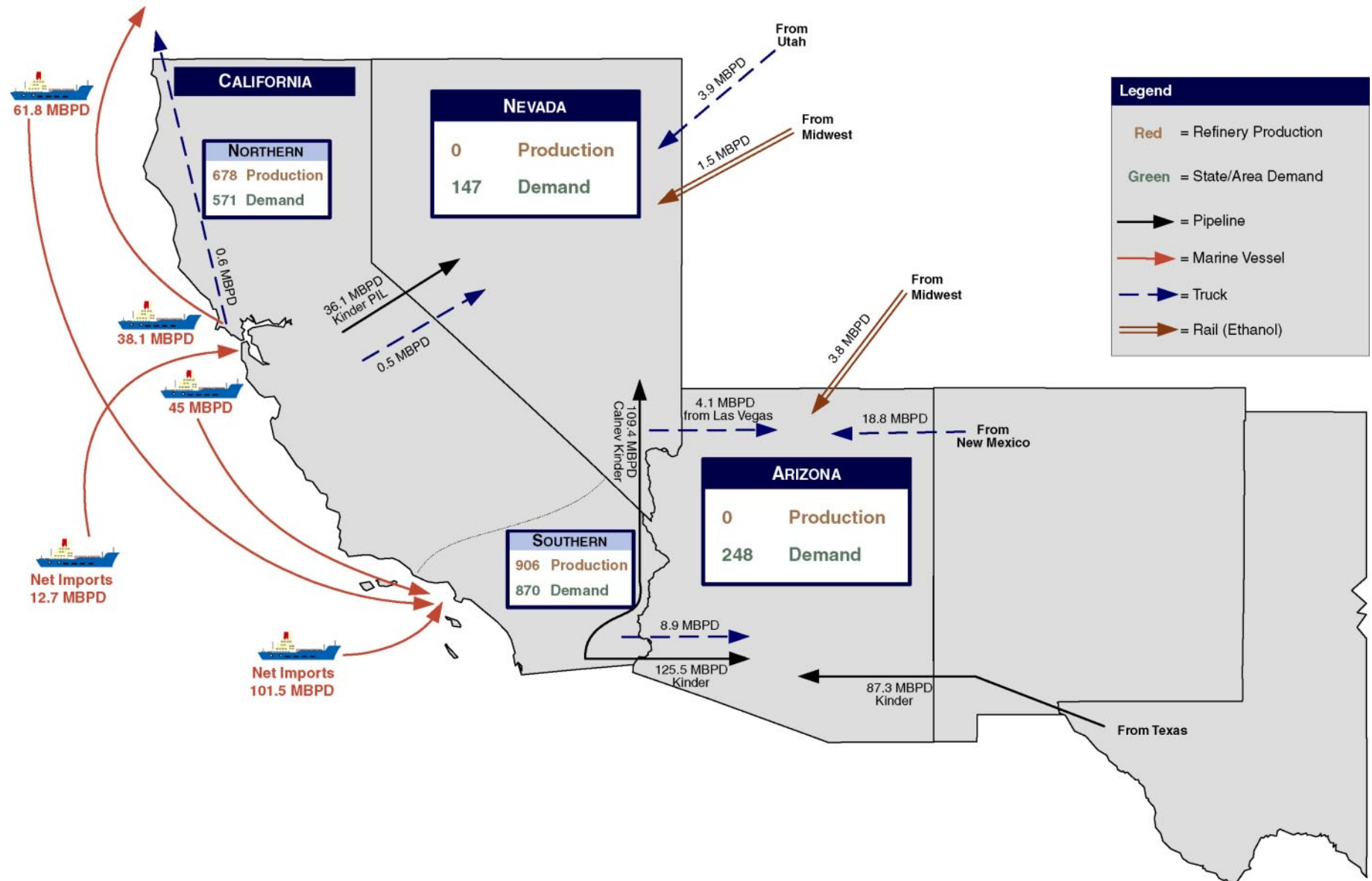


Figure 4. Year 2005 Southwestern States Refined Product Balance Estimate

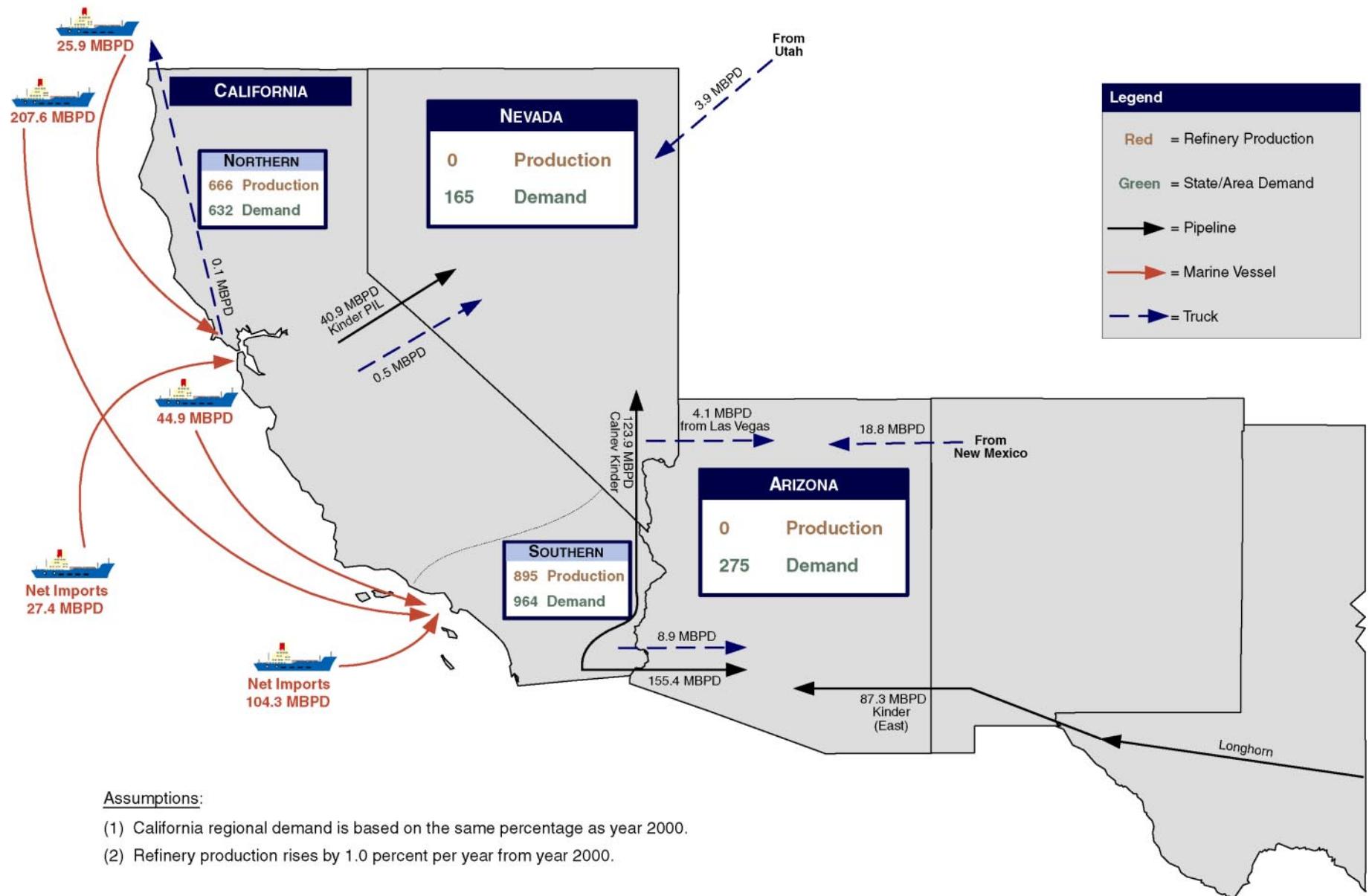
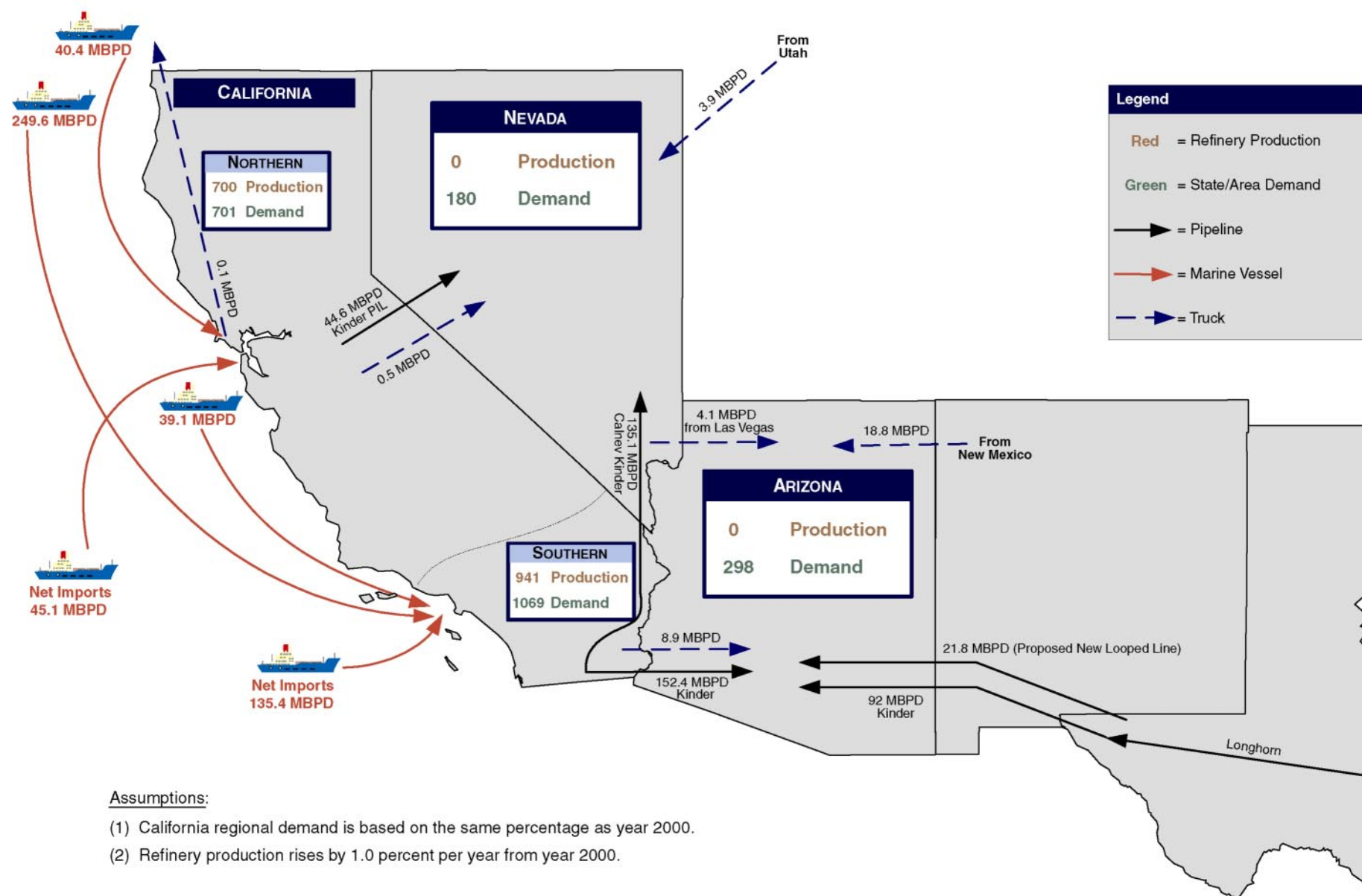


Figure 5. Year 2010 Southwestern States Refined Product Balance Estimate



APPENDIX B

TABLES

Table 1: Kinder Morgan Southwest Pipeline Segments

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (MBPD)	2000 Throughput (MBPD)	Products
1	Watson to Norwalk	12.8	24	520	TBD	Unleaded gas, jet fuel, and diesel fuel
		12.2	16			
		13	16			
2	Norwalk to Colton	50	24	520	TBD	
		49.4	16			
		49.4	16			
3	Norwalk to Orange	14.8	16	144	TBD	
4	Orange to Mission Valley	101.4	16	144	TBD	
5	Colton to Niland to Phoenix	321.9	24/20	200	TBD	
6	Niland to Imperial		6	30	TBD	
7	Mission Valley (San Diego) to San Diego Harbor	7.9	10	N/A	TBD	
8	Colton to Las Vegas (CalNev)	550	8 14	138	TBD	
9	Phoenix to Tucson	TBD	6	14	TBD	
10	Tucson to Phoenix	TBD	12/8	55	TBD	
11	El Paso to Tucson	TBD	8 12	95	TBD	

Table 2: Kinder Morgan Northern California Pipeline Segments

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (MBPD)	2000 Throughput* (MBPD)	Products
1	Concord to San Jose	TBD	10	96	TBD	
2	Concord to Stockton and Bradshaw	TBD	10/8	95	TBD	
3	Concord to Sacramento and Rocklin (connects to Reno and Chico pipeline systems)	TBD	14 12	152	TBD	
4	Rocklin to Reno	TBD	10/8/6	45	TBD	
5	Rocklin to Chico	TBD	8	41	TBD	
6	Concord to Fresno	TBD	12	63	TBD	
7	Richmond to Brisbane	TBD	12 10	63	TBD	
8	Concord to Richmond	TBD	8	63	TBD	
9	Bakersfield to Fresno	TBD	8	63	TBD	

Table 3: New Mexico Pipeline Segments**Chevron Pipe Line Company**

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (MBPD)	2000 Throughput (MBPD)	Products
1	El Paso to Albuquerque	N/A	6	N/A	N/A	

Navajo Pipeline Company (Holly Corporation)

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (MBPD)	2000 Throughput (MBPD)	Products
1	Navajo/Artesia to El Paso (via Orla -- Southern)	N/A	8/12	N/A	N/A	
2	Navajo/Artesia to El Paso (Northern)	N/A	6	N/A	N/A	

Equilon Pipeline Company

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (MBPD)	2000 Throughput (MBPD)	Products
1	East Houston terminal to Odessa (through Corsicana) - Orion	N/A	16	N/A	18 (est)	Refined
2	Odessa, TX, to El Paso	500	16	N/A	N/A	

Shamrock Logistics

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (mbpd)	2000 Throughput (mbpd)	Products
1	McKee Refinery in TX to El Paso	408	10	60 (may be expanded to 80)	N/A	(Also batches propane)
2	McKee Refinery in TX to Albuquerque	N/A	6	26	N/A	

Table 4: Longhorn Pipeline Segments

#	Origin/Destination	Approx. Length (miles)	Diameter (inches)	Pipeline Capacity (MBPD)	2000 Throughput (MBPD)	Products
1	Galena Park station to EPC connection (J1)	9	20	72 initial 225 ultimate	0	Primarily gasoline and distillate products
2	J1 to Satsuma station	25	20	72 initial 225 ultimate	0	Primarily gasoline and distillate products
3	Satsuma station to Crane station	424	18	72 initial 225 ultimate	0	Primarily gasoline and distillate products
4	Crane station to El Paso	237	18	72 initial 225 ultimate	0	Primarily gasoline and distillate products
5	El Paso terminal to interstate pipelines laterals (not yet built)	8	Two 8 One 12	72 initial 225 ultimate	0	Primarily gasoline and distillate products
Total Length:		703				

Table 5: Year 2000 California Refinery Capacity (MBPD)

Refinery	Crude Capacity
Southern California	
BP/Amoco, Watson	260
Chevron, El Segundo	260
Edgington	25
Equilon, Wilmington	98
Exxon/Mobil, Torrance	148
Huntway	6
Paramount	45
Tosco, Los Angeles	131
Ultramar	79
Total Southern California	1052
Northern California	
Chevron, Richmond	225
Equilon, Bakersfield	62
Equilon, Martinez	155
Kern County Refining	25
San Joaquin Refining	24
Tosco, Rodeo	73
Ultramar, Avon	168
Valero, Benicia	135
Witco	6
Total Northern California	873
Total California	1925

Table 6: Year 2000 Refined Product (Gasoline, Diesel, and Jet Fuel) Supply/Demand Balance (MBPD)

	Northern California	Southern California	Total California	Nevada	Arizona	Total Region
DEMAND (Consumption)	571.4	870.5	1,441.9	147.3	248.3	1,837.5
SUPPLY						
Refinery Production	678.4	906.0	1,584.4	0.0	0.0	1,584.4
Marine Imports (Exports)						
Foreign	12.7	101.5	114.2	0.0	0.0	114.2
From Domestic	(38.1)	61.8	23.7	0.0	0.0	23.7
From Northern California	(45.0)	45.0	0.0	0.0	0.0	0.0
<i>Marine Subtotal</i>	<i>(70.3)</i>	<i>208.3</i>	<i>138.0</i>	<i>0.0</i>	<i>0.0</i>	<i>138.0</i>
Pipeline Imports (Exports)						
From Northern California	(36.1)	0.0	(36.1)	36.1	0.0	(0.0)
From Southern California	0.0	(234.9)	(234.9)	109.4	125.5	(0.0)
From Texas (Via KM El Paso)	0.0	0.0	0.0	0.0	87.3	87.3
<i>Pipeline Import Subtotal</i>	<i>(36.1)</i>	<i>(234.9)</i>	<i>(271.0)</i>	<i>145.5</i>	<i>212.8</i>	<i>87.3</i>
Rail Imports (Exports)						
Ethanol From Midwest				1.5	3.8	
Truck Imports (Exports)						
From Northern California	(0.6)	0.0	(0.6)	0.5	0.0	(0.0)
From Southern California	0.0	(8.9)	(8.9)	0.0	8.9	0.0
From Nevada	0.0	0.0	0.0	(4.1)	4.1	0.0
From New Mexico	0.0	0.0	0.0	0.0	18.8	18.8
From Utah	0.0	0.0	0.0	3.9	0.0	3.9
<i>Truck Imports Subtotal</i>	<i>(0.6)</i>	<i>(8.9)</i>	<i>(9.4)</i>	<i>0.3</i>	<i>31.8</i>	<i>22.6</i>
TOTAL SUPPLY	571.4	870.5	1,441.9	147.3	248.3	1,832.3

Note: Data for this table was supplied by the California Energy Commission.

Table 7: Year 2000 Gasoline Supply/Demand Balance (MBPD)

	Northern California	Southern California	Total California	Nevada	Arizona	Total Region
DEMAND (Consumption)	384.1	576.1	960.1	61.1	156.3	1,177.6
SUPPLY						
Refinery Production	442.7	604.9	1,047.6	0.0	0.0	1,047.6
Marine Imports (Exports)						
Foreign	1.3	10.6	11.9	0.0	0.0	11.9
From Domestic	(32.0)	61.8	29.8	0.0	0.0	29.8
From Northern California	(10.5)	10.5	0.0	0.0	0.0	0.0
<i>Marine Subtotal</i>	<i>(41.3)</i>	<i>83.0</i>	<i>41.7</i>	<i>0.0</i>	<i>0.0</i>	<i>41.7</i>
Pipeline Imports (Exports)						
From Northern California	(17.3)	0.0	(17.3)	17.3	0.0	0.0
From Southern California	0.0	(107.9)	(107.9)	44.4	63.5	0.0
From Texas	0.0	0.0	0.0	0.0	68.2	68.2
<i>Pipeline Import Subtotal</i>	<i>(17.3)</i>	<i>(107.9)</i>	<i>(125.2)</i>	<i>61.7</i>	<i>131.7</i>	<i>68.2</i>
Rail Imports (Exports)						
Ethanol From Midwest				1.5	3.8	5.3
Truck Imports (Exports)						
From Northern California	(0.0)	0.0	(0.0)	0.0	0.0	(0.0)
From Southern California	0.0	(3.9)	(3.9)	0.0	3.9	0.0
From Nevada	0.0	0.0	0.0	(4.1)	4.1	0.0
From New Mexico	0.0	0.0	0.0	0.0	12.9	12.9
From Utah	0.0	0.0	0.0	2.0	0.0	2.0
<i>Truck Imports Subtotal</i>	<i>(0.0)</i>	<i>(3.9)</i>	<i>(3.9)</i>	<i>(2.1)</i>	<i>20.9</i>	<i>14.9</i>
TOTAL SUPPLY	384.1	576.1	960.2	61.1	156.3	1,177.6

Note: Data for this table was supplied by the California Energy Commission.

Table 8: Year 2000 Distillate (Diesel and Jet Fuel) Supply/Demand Balance (MBPD)

	Northern California	Southern California	Total California	Nevada	Arizona	Total Region
DEMAND (Consumption)	187.3	294.4	481.7	86.2	92.0	659.9
SUPPLY						
Refinery Production	235.7	301.1	536.8	0.0	0.0	536.8
Marine Imports (Exports)						
Foreign	11.4	90.9	102.3	0.0	0.0	102.3
From Domestic	(6.1)	0.0	(6.1)	0.0	0.0	(6.1)
From Northern California	(34.4)	34.4	0.0	0.0	0.0	0.0
<i>Marine Subtotal</i>	<i>(29.1)</i>	<i>125.3</i>	<i>96.3</i>	<i>0.0</i>	<i>0.0</i>	<i>96.3</i>
Pipeline Imports (Exports)						
From Northern California	(18.8)	0.0	(18.8)	18.8	0.0	(0.0)
From Southern California	0.0	(127.0)	(127.0)	65.0	62.0	(0.0)
From Texas	0.0	0.0	0.0	0.0	19.1	19.1
<i>Pipeline Import Subtotal</i>	<i>(18.8)</i>	<i>(127.0)</i>	<i>(145.8)</i>	<i>83.8</i>	<i>81.1</i>	<i>19.1</i>
Truck Imports (Exports)						
From Northern California	(0.5)	0.0	(0.5)	0.5	0.0	(0.0)
From Southern California	0.0	(5.0)	(5.0)	0.0	5.0	0.0
From Nevada	0.0	0.0	0.0	0.0	0.0	0.0
From New Mexico	0.0	0.0	0.0	0.0	5.9	5.9
From Utah	0.0	0.0	0.0	1.9	0.0	1.9
<i>Truck Imports Subtotal</i>	<i>(0.5)</i>	<i>(5.0)</i>	<i>(5.5)</i>	<i>2.4</i>	<i>10.9</i>	<i>7.8</i>
TOTAL SUPPLY	187.3	294.4	481.7	86.2	92.0	659.9

Note: Data for this table was supplied by the California Energy Commission.

Table 9: Refined Product Demand (Consumption) Projected Through 2010

Population Growth Projections	2000	2001	2002	2003	2004	2005	2010
Arizona	4,798 2.3%	4,897 2.1%	4,990 1.9%	5,077 1.7%	5,157 1.6%	5,230 1.4%	5,522 5.6%
Nevada	1,871 3.3%	1,924 2.8%	1,970 2.4%	2,010 2.0%	2,043 1.6%	2,070 1.3%	2,131 2.9%
New Mexico	1,860 1.8%	1,893 1.8%	1,925 1.7%	1,956 1.6%	1,987 1.6%	2,016 1.5%	2,155 6.9%
California	32,521 0.7%	32,805 0.9%	33,138 1.0%	33,521 1.2%	33,956 1.3%	34,441 1.4%	37,644 9.3%
Combined	41,050 1.1%	41,519 1.1%	42,023 1.2%	42,564 1.3%	43,143 1.4%	43,757 1.4%	47,452 8.4%

Gasoline Demand (MBPD)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
California	960.1	975.5	991.1	1,007.0	1,023.1	1,039.5	1,056.1	1,073.0	1,090.2	1,107.6	1,125.3
Arizona	156.3	159.6	162.6	165.4	168.0	170.4	172.3	174.2	176.2	178.2	180.1
Nevada	61.1	62.9	64.4	65.7	66.7	67.6	68.0	68.4	68.8	69.2	69.6
New Mexico											
Total:	1,177.6	1,197.9	1,218.1	1,238.1	1,257.9	1,277.5	1,296.4	1,315.7	1,335.2	1,355.0	1,375.1

Diesel and Jet Fuel Demand (MBPD)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
California	481.7	495.9	510.5	525.5	540.9	556.9	573.3	590.2	607.7	625.6	644.2
Arizona	92.0	94.3	96.7	99.1	101.6	104.1	106.7	109.4	112.1	114.9	117.8
Nevada	86.2	88.4	90.6	92.8	95.1	97.5	100.0	102.5	105.0	107.7	110.3
New Mexico											
Total:	659.9	678.5	697.7	717.4	737.6	758.5	780.0	802.1	824.8	848.2	872.3

Total Refined Products Demand (MBPD)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
California	1,441.9	1,471.4	1,501.6	1,532.5	1,564.0	1,596.4	1,629.4	1,663.2	1,697.8	1,733.2	1,769.5
Arizona	248.3	253.9	259.3	264.5	269.6	274.5	279.0	283.6	288.3	293.1	297.9
Nevada	147.3	151.2	154.9	158.5	161.9	165.2	168.0	170.9	173.9	176.9	180.0
New Mexico	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total:	1,837.5	1,876.5	1,915.8	1,955.5	1,995.5	2,036.0	2,076.4	2,117.7	2,160.0	2,203.2	2,247.4

Gasoline demand in Arizona and Nevada is projected to grow at the same rate as population growth as has historically been the case. Diesel and jet fuel demand is projected to grow at 2.5% per year for Arizona and Nevada and 2.95% per year for California.

Note: Data for this table was supplied by the California Energy Commission.

Table 10: Year 2005 Refined Product (Gasoline, Diesel, and Jet Fuel) Supply/Demand Balance (MBPD)

	Northern California	Southern California	Total California	Nevada	Arizona	Total Region
DEMAND (Consumption)	632.4	964.0	1596.4	165.2	274.5	2,036.0
SUPPLY						
Refinery Production	665.5	895.4	1560.9	0.0	0.0	1,560.9
Marine Imports (Exports)						
Foreign	27.4	104.3	131.7	0.0	0.0	131.7
From Domestic/Foreign	25.9	207.6	233.5	0.0	0.0	233.5
From Northern California	(44.9)	44.9	0.0	0.0	0.0	0.0
<i>Marine Subtotal</i>	<i>8.3</i>	<i>356.8</i>	<i>365.2</i>	<i>0.0</i>	<i>0.0</i>	365.2
Pipeline Imports (Exports)						
From Northern California	(40.9)	0.0	(40.9)	40.9	0.0	0.0
From Southern California	0.0	(279.4)	(279.4)	123.9	155.4	0.0
From Texas (Via KM El Paso)	0.0	0.0	0.0	0.0	87.3	87.3
New Loop Line El Paso - AZ	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pipeline Import Subtotal</i>	<i>(40.9)</i>	<i>(279.4)</i>	<i>(320.3)</i>	<i>164.9</i>	<i>242.7</i>	87.3
Truck Imports (Exports)						
From Northern California	(0.6)	0.0	(0.6)	0.5	0.0	(0.0)
From Southern California	0.0	(8.9)	(8.9)	0.0	8.9	0.0
From Nevada	0.0	0.0	0.0	(4.1)	4.1	0.0
From New Mexico	0.0	0.0	0.0	0.0	18.8	18.8
From Utah	0.0	0.0	0.0	3.9	0.0	3.9
<i>Truck Imports Subtotal</i>	<i>(0.6)</i>	<i>(8.9)</i>	<i>(9.4)</i>	<i>0.3</i>	<i>31.8</i>	22.6
TOTAL SUPPLY	632.4	964.0	1596.4	165.2	274.5	2,036.0

Note: Data for this table was supplied by the California Energy Commission.

Table 11: Year 2010 Refined Product (Gasoline, Diesel, and Jet Fuel) Supply/Demand Balance (MBPD)

	Northern California	Southern California	Total California	Nevada	Arizona	Total Region
DEMAND (Consumption)	700.8	1068.7	1769.5	180.0	297.9	2,247.4
SUPPLY						
Refinery Production	699.5	941.0	1640.5	0.0	0.0	1,640.5
Marine Imports (Exports)						
Foreign	45.1	135.4	180.4	0.0	0.0	180.4
From Domestic/Foreign	40.4	249.6	290.0	0.0	0.0	290.0
From Northern California	(39.1)	39.1	0.0	0.0	0.0	0.0
<i>Marine Subtotal</i>	<i>46.4</i>	<i>424.1</i>	<i>470.5</i>	<i>0.0</i>	<i>0.0</i>	<i>470.5</i>
Pipeline Imports (Exports)						
From Northern California	(44.6)	0.0	(44.6)	44.6	0.0	0.0
From Southern California	0.0	(287.5)	(287.5)	135.1	152.4	0.0
From Texas (Via KM El Paso)	0.0	0.0	0.0	0.0	92.0	92.0
New Loop Line El Paso - AZ	0.0	0.0	0.0	0.0	21.8	21.8
<i>Pipeline Import Subtotal</i>	<i>(44.6)</i>	<i>(287.5)</i>	<i>(332.1)</i>	<i>179.7</i>	<i>266.2</i>	<i>113.8</i>
Truck Imports (Exports)						
From Northern California	(0.6)	0.0	(0.6)	0.5	0.0	(0.0)
From Southern California	0.0	(8.9)	(8.9)	0.0	8.9	0.0
From Nevada	0.0	0.0	0.0	(4.1)	4.1	0.0
From New Mexico	0.0	0.0	0.0	0.0	18.8	18.8
From Utah	0.0	0.0	0.0	3.9	0.0	3.9
<i>Truck Imports Subtotal</i>	<i>(0.6)</i>	<i>(8.9)</i>	<i>(9.4)</i>	<i>0.3</i>	<i>31.8</i>	<i>22.6</i>
TOTAL SUPPLY	700.8	1068.7	1769.5	180.0	297.9	2,247.4

Note: Data for this table was supplied by the California Energy Commission.

Table 12: Conceptual Pipeline Data by State and County

County	Pipeline Mileage	Pipeline Fill (BBL)	Population	Population Per Sq Mile
TEXAS				
Bell	35	103,390	237,974	224.5
Brazos	17	50,218	152,415	260.1
Brown	22	64,988	37,674	39.9
Coke	35	103,390	3,864	4.3
Coleman	30	88,620	9,235	7.3
Coryell	29	85,666	74,978	71.3
Culberson	54	159,516	2,975	0.8
Ector	31	91,574	121,123	134.4
El Paso	23	67,942	679,622	670.9
Falls	2	5,908	18,576	24.2
Glasscock	30	88,620	1,406	1.6
Grimes	22	64,988	23,552	29.7
Harris	37	109,298	3,400,578	1,966.8
Hudspeth	66	194,964	3,344	0.7
Lampasas	10	29,540	17,762	24.9
Loving	29	85,666	67	0.1
Midland	31	91,574	116,009	128.9
Milam	23	67,942	24,238	23.8
Mills	36	106,344	5,151	6.9
Montgomery	34	100,436	293,768	281.4
Reeves	14	41,356	13,137	5.0
Robertson	16	47,264	16,000	18.7
Runnels	31	91,574	11,495	10.9
Sterling	26	76,804	1,393	1.5
Winkler	33	97,482	7,173	8.5
Texas Total	716	2,115,064		

Table 12: Conceptual Pipeline Data by State and County (continued)

County	Pipeline Mileage	Pipeline Fill (BBL)	Population	Population Per Sq Mile
NEW MEXICO				
Dona Ana	56	165,424	174,682	45.9
Grant	18	53,172	31,002	7.8
Hidalgo	33	97,482	5,935	1.7
Luna	55	162,470	25,016	8.4
Otero	1	2,954	62,298	9.4
New Mexico Total	163	481,502		
ARIZONA				
Cochise	87	256,998	117,755	19.1
Maricopa	76	224,504	3,072,149	338.8
Pima	12	35,448	843,746	91.9
Pinal	109	321,986	179,727	33.5
Yuma	70	206,780	160,026	29.0
Arizona Total	354	1,045,716		
CALIFORNIA				
Riverside	157	463,778	1,545,387	214.2
San Bernardino	23	67,942	1,709,434	85.2
California Total	180	531,720		
GRAND TOTAL		4,174,002		

Table 13: Historical Pump Station Construction Costs¹**1998-2000 North American Compressor Construction Costs - New Installations²**

	Horsepower	Equipment & Material	Labor	Land	Misc.	Total	\$/HP
	3,335	2,529,398	1,359,393	50,000	3,528,981	7,467,772	2,239
	3,335	3,499,021	1,930,287	80,000	3,953,633	9,462,941	2,837
	3,799	2,645,436	2,012,290	2,670	1,313,996	5,974,392	1,573
	3,936	2,333,334	1,774,885	2,355	1,158,974	5,269,548	1,339
	4,445	2,792,872	1,274,851	50,000	3,567,651	7,685,374	1,729
	7,000	7,000,000	4,716,000	200,000	2,084,000	14,000,000	2,000
Totals	25,850	\$20,800,061	\$13,067,706	\$385,025	\$15,607,235	\$49,885,877	\$1,930
Average	4,308	\$3,466,677	\$2,177,951	\$64,171	\$2,601,206	\$8,310,005	\$1,953

2001 Texas Region C Water Pump Station Cost Estimates³

	Horsepower	Equipment & Material	Labor	Land	Misc.	Total	\$/HP
	1,000	2,400,000	-Included-	-Included-	-Included-	2,400,000	2,400
	2,000	3,500,000	-Included-	-Included-	-Included-	3,500,000	1,750
	3,000	4,200,000	-Included-	-Included-	-Included-	4,200,000	1,400
	4,000	5,100,000	-Included-	-Included-	-Included-	5,100,000	1,275
	5,000	5,800,000	-Included-	-Included-	-Included-	5,800,000	1,160
	6,000	6,600,000	-Included-	-Included-	-Included-	6,600,000	1,100
	7,000	7,200,000	-Included-	-Included-	-Included-	7,200,000	1,029
	8,000	7,800,000	-Included-	-Included-	-Included-	7,800,000	975
	9,000	8,500,000	-Included-	-Included-	-Included-	8,500,000	944
	10,000	9,000,000	-Included-	-Included-	-Included-	9,000,000	900

Notes:

- 1) The pump station costs are based on construction costs of similar installations for which recent construction costs are available.
- 2) Compressor stations are generally more complex and costly than liquid product pipeline pump stations on a comparable size basis.
- 3) These water main pump stations are similar in design and complexity to liquid oil product pump stations.

Table 14: Historical Land Pipeline Construction Costs - 1990 to 2001¹

Average Costs (\$/mile)						
Size	Year	ROW	Material	Labor	Misc.	Total
12-inch	1990	105,535	142,336	353,859	232,572	834,302
	1991	37,200	79,613	213,538	46,559	376,910
	1992	52,393	88,806	208,998	92,076	442,273
	1993	66,963	67,193	180,631	74,783	389,570
	1994	62,341	67,475	249,999	85,520	465,335
	1995	43,380	73,442	218,532	134,362	469,716
	1996	49,673	106,937	279,001	137,539	573,150
	1997	28,004	99,128	328,848	101,378	557,358
	1998*	-	-	-	-	-
	1999	28,786	380,886	1,331,040	827,938	2,568,650
	2000	30,721	83,069	264,461	163,653	541,904
	2001	88,592	83,940	481,060	267,073	920,665
					Average:	\$739,985
16-inch	1990	63,994	122,186	157,792	76,076	420,048
	1991	9,382	99,730	206,120	46,457	361,689
	1992	27,820	99,993	235,743	87,841	451,397
	1993	78,043	101,414	218,692	91,585	489,734
	1994	78,881	102,278	403,726	121,149	706,034
	1995	14,025	101,351	116,438	66,803	298,617
	1996	42,524	84,617	177,395	61,059	365,595
	1997	43,712	111,091	417,024	127,412	699,239
	1998	38,093	455,896	324,772	232,192	1,050,953
	1999	127,078	237,824	442,903	275,440	1,083,245
	2000	132,500	121,675	374,154	359,815	988,144
	2001	30,964	146,191	592,557	464,233	1,233,945
					Average:	\$679,053
24-inch	1990	54,631	193,527	277,460	123,844	649,462
	1991	19,013	158,756	220,900	55,916	454,585
	1992	20,905	151,227	321,542	107,278	600,952
	1993	691,800	3,163,400	5,949,700	2,800,400	12,605,300*
	1994	33,671	198,864	332,775	123,084	688,394
	1995	5,542	260,444	405,910	96,201	768,097
	1996	106,795	249,421	655,392	265,939	1,277,547
	1997*	-	-	-	-	-
	1998	28,232	252,140	1,069,049	514,710	1,864,131
	1999	27,662	187,217	239,619	109,016	563,514
	2000	119,147	238,555	461,141	327,696	1,146,539
	2001	130,504	241,517	540,604	281,141	1,193,766
					Average:	\$920,699
*Value disregarded; only one project was proposed for this year with unusually high costs.						
Notes:						
	1) Based on FERC and National Energy Board (Canada) construction permit applications for a 12-month period ending June 30 of each year, as compiled by the Oil & Gas Journal.					

Table 15: Selected Pipeline Construction Projects - 1998 to 2000¹

Size (inches)	Length (miles)	Costs (\$)				\$/mile
		Material	Labor	Other	Total	
8	3.655	416,123	1,538,757	200,101	2,154,981	589,598
8	4.600	1,015,875	1,840,276	0	2,856,151	620,902
8	3.010	150,761	741,193	59,290	951,244	316,028
12	0.795	254,100	336,735	107,272	698,107	877,620
12	9.800	1,282,995	1,780,027	445,128	3,508,150	357,974
12	0.800	134,812	158,043	13,367	306,222	382,778
12	5.620	423,000	1,603,000	2,075,000	4,101,000	729,715
12	2.930	244,000	1,180,000	1,781,000	3,205,000	1,093,857
12	6.610	551,000	1,955,000	3,118,000	5,624,000	850,832
12	4.800	377,125	665,191	98,307	1,140,623	237,630
16	10.500	1,620,183	2,093,448	575,353	4,288,984	408,475
16	21.890	4,589,668	9,994,728	419,026	15,003,422	685,401
16	0.459	49,067	67,759	0	116,826	254,472
16	0.265	58,918	354,861	0	413,779	1,560,538
16	1.100	342,633	718,134	3,500	1,064,267	967,515
16	1.800	493,737	578,890	33,114	1,105,741	614,301
18	1.103	309,581	473,015	126,323	908,919	824,020
20	4.400	604,400	2,678,360	450,251	3,733,011	848,412
20	4.034	957,939	1,487,228	149,180	2,594,347	643,106
20	0.849	172,627	363,863	216,267	752,757	886,782
20	0.663	642,895	60,571	0	703,466	1,061,229
20	2.250	494,218	1,041,871	476,455	2,012,544	894,464
20	0.979	169,941	486,837	51,420	708,198	723,686
20	2.160	237,078	1,525,377	402,146	2,164,601	1,002,130
20	0.322	35,579	152,971	24,446	212,996	661,541
24	0.290	128,330	20,169	820,212	968,711	3,345,189
24	0.900	241,402	670,186	41,373	952,961	1,058,846
24	0.341	148,998	1,246,846	290,118	1,685,962	4,945,489
26	0.905	318,289	406,697	204,272	929,258	1,026,461
26	1.050	1,302,000	1,811,210	349,790	3,463,000	3,298,095
26	1.800	922,596	1,858,847	197,046	2,978,489	1,654,716
Totals:	100.680	\$18,689,870	\$39,890,090	\$12,727,757	\$71,307,717	\$708,262
Average/mile:		\$185,637	\$396,207	\$126,418		
Alliance Pipeline (U.S. portion)						
36	888	465,417,000	525,638,000	148,154,700	1,139,209,700	\$1,282,894
Directional drill under highways and waterways						
18	0.341	481,825	73,690	93,889	649,404	N/A
24	0.606	23,284	1,585,493	299,437	1,908,214	N/A
24	0.284	122,928	343,214	25,547	491,689	N/A
30	0.284	176,967	353,247	28,061	558,275	N/A
Average:					\$901,896	

Notes:

- 1) Selected projects from FERC CY2000 & 1999 Annual Construction Reports (157.207 Reports).
These projects are across all areas of the United States.

APPENDIX C

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